ACCLIMATIZATION DEMANDS OF RECREATIONISTS MOVING WITHIN THE SOUTHERN REGION OF THE RUSSIAN FAR EAST

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ABSTRACT Recreation often involves traveling to a distant place at which the climatic conditions differ from those the recreationist is used to. If the climatic conditions at the holiday destination are very different, it may be necessary to take into account the thermal strain of the body expressed as an adjustment loading. This phenomenon is also called "acclimatization thermal loading" and first affects the respiratory system. It is of special importance for people considering to travel to Siberia and the Russian Far East, where they would have to cope with long periods of extreme cold. The effects of travel from the centre of the Russian Far East Federal Okrug – Khabarovsk to all locations of this district are examined. In the period from September to March, respiratory organs acclimatization loading is positive for visitors moving from Khabarovsk to the south of territory to Vladivostok. This means that they will experience a reduction of the stress level of respiratory organs. In summer, when the sun-bathing season begins, it is better to travel to the far south of Primorye, but only in July and August. The northern part of the territory is well suited to eco tourism, hunting and fishing, but only a healthy person who is not affected badly by large changes in the respiratory loading should go there. It is not advisable that weak or ill individuals visit this area, as acclimatization loading is negative throughout the year.

KEYWORDS*: respiratory organs, heat losses, acclimatization thermal loading, tourism, interregional traveling, monsoon climate, Russian Far East*

INTRODUCTION

Weather and climate can have a large effect on the thermal condition of the human body, which is determined by the body-atmosphere heat balance (De Freitas, 1985). Recreation often involves traveling to a distant place at which the climatic conditions differ from those the recreationist is used to. If the climatic conditions at the holiday destination are very different, it may be necessary to take into account the thermal strain of the body expressed as an adjustment loading. This phenomenon is also called "acclimatization thermal loading" and first affects the respiratory system (Rusanov, 1989).

Regulation of heat exchange is one of the fundamental ways the human body maintains a constant core temperature. Heat loss through skin accounts for about 82 % of the entire heat loss, while about 13 % heat loss occurs through respiration (Rusanoiv, 1973). In the winter period, when the skin is covered by clothing, the respiratory organs are not protected from the influence of cold conditions, and thus are the main way of heat loss. Under certain conditions losses of heat via respiratory organs could comprise as much as 30 % of the body's heat losses (Rusanov, 1989), which could result in a cold. Given long periods of extreme cold in Siberia and the Russian Far East, this holds special importance for people considering to travel to these places for recreation. Variability is also large; it is estimated that heat loss from the body within these regions differs by up to 300 % (Matukhin, 1971, Derkatcheva, 2000).

METHODS

Data for the study area is drawn from 53 hydrometeorological stations (HMS) in Khabarovsky Krai, Primorsky Kray, Amursk Region and Jewish Autonomous Region, situated at the northern latitudes from 43^o to 57^o and at the eastern longitudes from 125^o to 142^o (Scientific - Applied Climate Book of the USSR, 1988, 1992). Data on mean monthly and mean yearly air temperature, relative humidity and wind velocity are used.

Heat loss of the human body for an average man Q_l (W) are estimated by a simple technique that takes into account the heat loss from the respiratory track caused by heating of inhaled air P_l (W) and evaporative heat loss caused by moisture loss from the surface of respiratory organs, depending on the temperature and relative humidity of air LE (W) using formula of Rusanov (1989):

$$Q_l = P_l + LE.$$

The rate of respiration depends on the level of physical activity, and heat exchange rates have to be adjusted accordingly. There may be two corrections: the first one for the differences in atmospheric pressure, and the second for higher altitude. The very small differences in average atmospheric pressure in the study areas mean that their effects can be ignored. The second correction may be ignored for the weathers stations located in the lowland plains, all located at heights below 500 m a.s.l. However, a correction for increased lung ventilation must be taken into account at the mountain stations in Khabarovsky Krai – Sofiisky Priisk (902 m a.s.l.) and Solekul (899 m a.s.l.).

Wind has a significant influence on respiratory heat loss by increasing lung ventilation and respiratory organs heat loss. Strong winds that are common in the coastal territories during

times of low air temperatures increase an already strongly negative body heat balance. Hence, for a reliable estimation of respiratory heat losses in various climatic conditions, it is necessary to take wind speed into account. This is done by using an adjusted temperature from the work of Arnoldy (1962) given as

$$t_A = t - 2 * V$$

where t_A is adjusted temperature (^oC), t is the temperature of the air outdoors (^oC), and V is wind speed ($m\ s^{-1}$).

The absolute heat loss values are compared with the physiological norm of 15 W, the latter is based on winter heat losses in the resort Arkadia-Lermontovsky near Sochi. In this case, losses create discomfort at any relative humidity level with air temperatures below 5 ^oC (Rusanov, 1989). Research on conditions in the Far North and in Antarctic Continent shows that heat loss of more than 50 W can cause human overcooling, resulting in lung chilblain or death. Respiratory organs acclimatization loading (ROAL) is calculated as the ratio of heat loss at the tourist's home location to heat loss at the holiday destination upon arrival, expressed as a percentage (Rusanov, 1989). Thus, a value equal to zero means there is no loading. If the calculated value is greater than zero, a tourist experiences a reduction of the ROAL. The negative value means an increase in the acclimatization loading and heat loss from the respiratory track.

Most of the study area is located in the temperate monsoon climatic zone characterized by an extreme continental regime of annual temperatures. The annual temperature range is 45-50 ^oC, the annual mean temperatures are between -7.3 ^oC and 4.5 ^oC, which characterizes the continentality of Middle Siberia. Several authors (e.g. Matukhin, 1971, Gorbatcevich, 1894) have highlighted the extreme bioclimates found in these areas: conditions in the southern Far East in winter are similar to those in Siberia; and in summer they are comparable to the warm, humid tropics. Human discomfort in monsoon climatic conditions of the Far East is a function of the combination of the low temperatures and high wind speed in winter and the combination of high air temperatures with high relative humidity creating an unpleasant, sultry feeling in summer (Grigorieva and Khristoforova, 2004).

RESULTS

The analysis of respiratory organs acclimatization loading shows that heat loss by respiration for a human at rest or at different levels of physical work in the winter period from November to March can be as much as seven times above the physiological norm. For example, Figure 1 shows the heat loss of a person in Khabarovsk over the year. For light work, seasonal

differences are one and a half times higher in winter than in spring and autumn, and two times higher than in summer (Fig. 1). It is necessary to take into account the differences caused by activity levels and difference between home location and holiday destination. For example, if a person is normally engaged in light activity at his or her home location, but plans a more sedentary activity at the holiday destination, this needs to be considered in the assessment. There are also spatial differences caused by variations in climatic conditions, as it is shown in Figure 2.

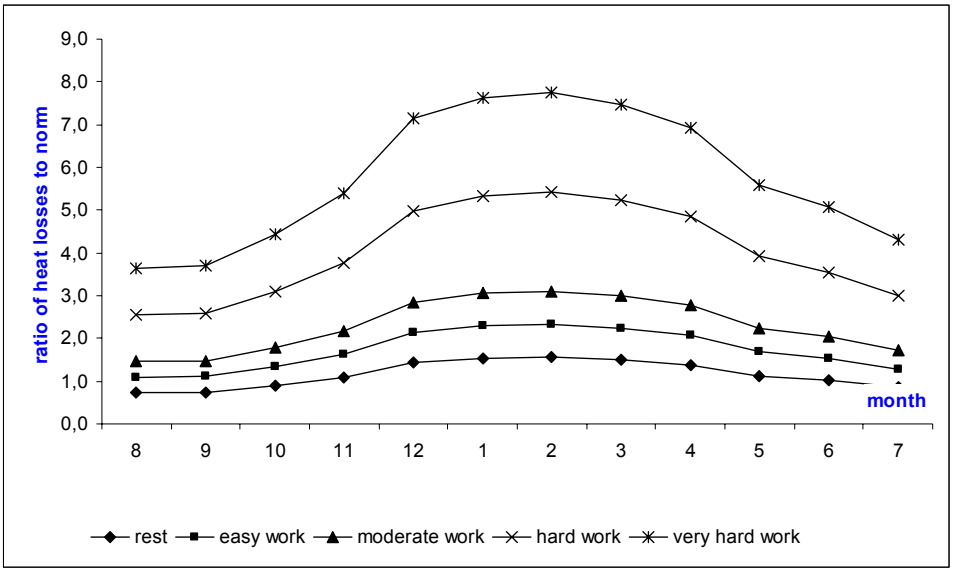

Figure 1: Ratio of respiratory heat losses to normal (15 W) depending on activity level at Khabarovsk

The results show that in winter changes are caused by temperatures decreasing steadily from south to north. In the mountainous locations, winter heat losses are two times higher than at low level locations in the interior plains. In the mountains, respiratory heat stress at rest is 15 W even in summer, which is due to increased lung ventilation because of low air pressures. Along the coasts of the Okhotsk and the Japanese seas, the climatic loading on respiratory organs is slightly higher than in the continental locations. Moreover, high mean monthly wind speeds of up to 6-8 m/s in the cold season increase the stress that is put on respiratory organs, which is in 15 % greater than those found at the coast. The results show that daily changes give rise to increased loadings on respiratory organs at night and in the early morning, caused by the low nocturnal temperatures and an increase in relative humidity at night and in the morning hours.

DISCUSSION

It is widely recognized that it is necessary to take into account the extent to which the climate at the holiday destination differs from that at the home location. This is particularly important if the purpose of the trip is rest or therapy. Figure 3 shows the effects of travel from the centre of the Russian Far East Federal Okrug – Khabarovsk to all locations of this district (Fig. 3).

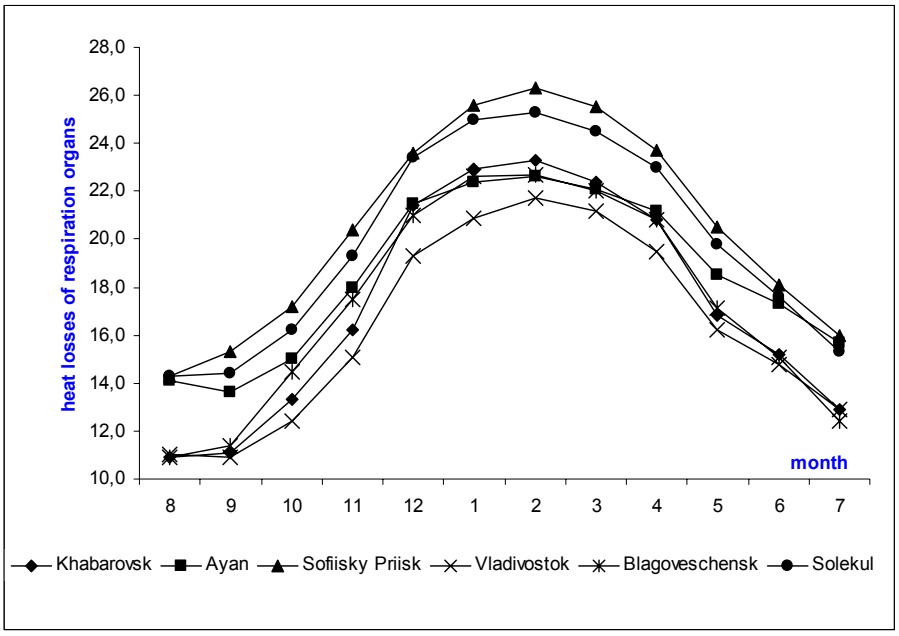

Figure 2: Spatial differentiation of respiratory heat losses in the southern region of the Russian Far East

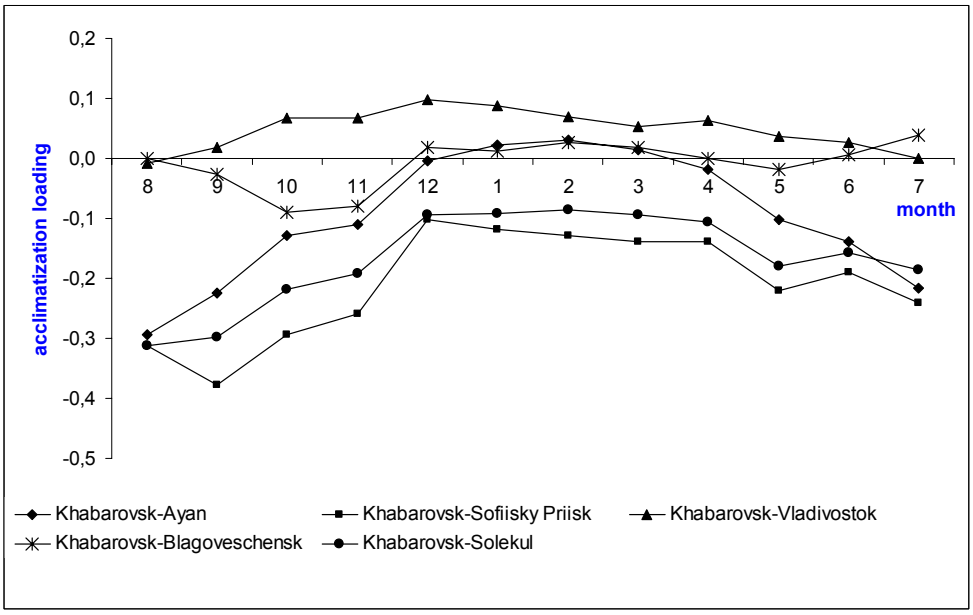

Figure 3: Acclimatization loading on respiratory organs for movement within the Russian Far East region

Figure 3 shows that, in the period from September to March, ROAL is positive for visitors moving to the south of territory from Khabarovsk to Vladivostok. This means they will

experience a reduction of the thermal stress put on the respiratory organs. The reason is higher temperatures of the cold season period in the south of Far East (at Vladivostok) compared to the temperatures of Khabarovsk at a higher latitude. In summer when the sun-bathing season begins, it is better to travel to the far south of the Primorye region with the administrative center in Vladivostok, and this only in July and August. This is because of the differences in action of the first phase of summer monsoon in Primorye (HMS Vladivostok) and Priamurye (HMS Khabarovsk). In Priamurye, the period from June to the first half of July is characterized by hot weather with a small amount of precipitation. In contrast to conditions in the central parts of the Far East monsoon climatic zone in Priamurye, the resort zone in Primorye in the south at this time is under the influence of the maritime air masses giving rise to foggy and cooler weather.

When travelling to the west of the district (Amur Region, HMS Blagoveschensk), the loading on respiratory organs is close to zero. A restful stay here is best done in winter or summer, as acclimatization loadings are slightly negative in autumn and spring.

The northern part of the territory is well suited to eco tourism, hunting and fishing, but only a healthy person who is not put off by large changes in respiratory loadings should go there. It is not advisable that weak or ill individuals visit this area, as the acclimatization loading is negative throughout the year (HMS Sofiisky Priisk, Solekul). In addition, the loadings are much higher than those discussed earlier. The increase of respiratory loadings caused by traveling to the coastal locations of the Okhotsk and the Japanese seas (HMS Ayan) is caused by higher wind speeds, especially in winter (Fig. 3). In all cases, acclimatization to new conditions should be gradual at the times indicated.

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